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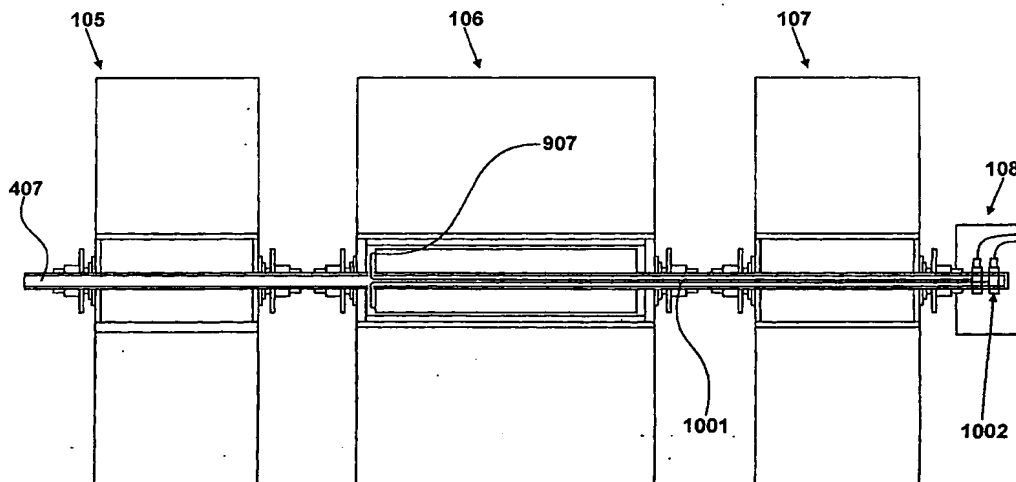
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(54) Title: GENERATOR



(57) Abstract: A wind powered generator comprising first and second current generator means arranged to generate electric current in response to relative rotation between the two generator means; at least one rotary part having vanes, the rotary part being operatively connected to one of the generator means and arranged to rotate in a first direction around an axial shaft when exposed to a flow of air perpendicular to the shaft; and said axial shaft is configured to receive electrical connection means therethrough, said electrical connection means configured to provide an electrical connection between said current generating means and generator electrical means.



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## Generator

### Background of the Invention

#### 1. Field of the Invention

5           The present invention relates to a generator, in particular a wind powered generator.

#### 2. Description of the Related Art

10           A first type of wind powered generator utilises a bladed rotor mounted on a vertical post. The rotor is configured to rotate about an axis of rotation when exposed to air flowing in a direction along that axis of rotation.

          A second type of wind powered generator utilises a bladed rotor configured to rotate about an axis of rotation when exposed to air flowing in a direction perpendicular to that axis of rotation.

15           A wind powered generator of this second type is disclosed in United Kingdom Patent number 2 341 646 B.

### Brief Summary of the Invention

20           According to a first aspect of the present invention there is provided a generator for generating an electric current comprising current generating means comprising first generator means and second generator means arranged to generate electric current in response to relative rotation between said first and second generator means; a first rotary part having vanes, said first rotary part arranged to rotate in a first direction around an  
25           axis when exposed to a flow of air perpendicular to said axis; said first

rotary part operatively connected to a first of said first and second generator means; and said axis is through an axial shaft about which said rotary part is arranged to rotate, wherein said axial shaft is configured to receive electrical connection means therethrough, said electrical connection means  
5 configured to provide an electrical connection between said current generating means and generator electrical means.

According to a second aspect of the invention there is provided a generator wherein said axial shaft comprises sections each releasably engageable with at least one other section.

10 According to a third aspect of the invention there is provided a generator wherein said electrical connection means comprises sections each releasably engageable with at least one other section.

### Brief Description of the Several Views of the Drawings

15 The invention will now be described by way of example only, with reference to the accompanying drawings in which:

*Figure 1* shows a wind powered generator embodying the present invention;

20 *Figure 2* shows an example of a rotary part utilisable in a wind powered generator embodying the present invention;

*Figure 3* shows rotary part barrier means arranged in stationary relation to the rotary part shown in *Figure 2*;

*Figure 4* shows a simplified section view, along line I-I of *Figure 1*, through a first rotary section of the wind powered generator of *Figure 1*;

25 *Figure 5* shows a simplified section view, along line II-II of *Figure 1*,

through a second rotary section of the wind powered generator of *Figure 1*;

*Figure 6* shows adjustable air flow control means arranged to control the flow of air into an air inlet region of a wind powered generator embodying the present invention;

5 *Figure 7* shows an enlarged view of the wind powered generator shown in *Figure 1*;

*Figure 8* shows a simplified schematic (with a cut-away section) of an arrangement of current generating means utilisable in a wind generator embodying the present invention;

10 *Figure 9* shows *Figure 9* shows a simplified schematic (with cut-away sections) of the arrangement of the current generating means and the rotary parts of the wind powered generator shown in *Figure 1*;

*Figure 10* is a diagrammatic longitudinal section view, along the line III-III of *Figure 1*, through the wind powered generator shown in *Figure 1*;

15 *Figure 11* is a diagrammatic longitudinal section view through a wind powered generator embodying the present invention;

*Figure 12* shows a rotary part configured to allow air to flow therethrough during rotation, utilisable in a wind powered generator embodying the present invention.

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### **Written Description of the Best Mode for Carrying Out the Invention**

#### ***Figure 1***

A wind powered generator 101 embodying the present invention is shown in *Figure 1*. The illustrated generator 101 is configured to be positioned in a natural wind environment and, in this example, is shown

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situated on the roof 102 of a building 103. An engineer 104 is shown standing adjacent the wind powered generator 101, performing routine maintenance and inspection work upon the generator 101.

As shown, generator 101 comprises a first rotary section 105, a  
5 second rotary section 106, a third rotary section 107 and a generator electrical means section 108. Generator 101 is also equipped with inlet ducting means 109 and outlet ducting means 110. Air flow through the generator 101 is indicated generally by arrows A and B.

Within each of the three rotary sections 105, 106, 107 of generator  
10 101 is a rotary part. An example of a rotary part utilisable in a wind generator embodying the present invention is shown in *Figure 2*.

### ***Figure 2***

Rotary part 201 is arranged to rotate about an axis when exposed to a  
15 flow of air perpendicular to the axis of rotation. In the example shown in *Figure 2*, rotary part 201 is arranged to rotate about an axial shaft 202, and comprises a hub 203 from which four arcuate vanes 204, 205, 206, 207 extend; alternatively a rotary part having one or more vanes is utilisable. The vanes 204, 205, 206, 207 are evenly distributed about the circumference of  
20 the hub 203. Each vane 204, 205, 206, 207 has three free edges, for example, edges 208, 209 and 210 of vane 204; with edges 208 and 210 being side edges, and edge 209 being the front edge, of vane 204.

Rotary part 201 is arranged to rotate in a first direction, indicated by  
arrow C, about axial shaft 202 when exposed to a flow of air perpendicular to  
25 axial shaft 202, in the direction indicated by arrow D; in response to rotative

air impinging on the underside of a vane, for example the underside 211 of vane 205.

As rotary part 201 rotates, each vane 204, 205, 206, 207 demarcates a vane free edge path 212 and a vane front edge path 213; a vane free edge path 212 being the path the free edges of a vane 204, 205, 206, 207 travel as the rotary part 201 rotates, and a vane front edge path 213 being the path the front edge of a vane 204, 205, 206, 207 travels as the rotary part 201 rotates.

### Figure 3

Figure 3 illustrates rotary part barrier means 301 arranged in stationary relation to rotary part 201. Barrier means 301 is configured to provide a barrier sector for rotary part 201, for example barrier sector 302 comprising a barrier around a portion of the vane free edge path 212 of rotary part 201, extending between an air inlet region 303 in which a portion of the vane front edge path 213 is exposed to allow the underside of a vane 204, 205, 206, 207 to be exposed to a flow of air and an air outlet region 304 in which a portion of the vane front edge path 213 is exposed to allow the underside of a vane 204, 205, 206, 207 to be exposed following rotation through the barrier sector 302. According to the example shown in Figure 3, as rotary part 201 rotates in the direction indicated by arrow C, inflowing air, as indicated by arrow E, flows through air inlet region 303 and is discharged through air outlet region 304, as indicated by arrow F.

In the example shown in Figure 3, barrier means provides a second barrier sector between air outlet region 304 and air inlet region 303, in the

direction indicated by arrow C. First and second portions of the free edge vane path of rotary part **201** are exposed in air inlet region **303** and air outlet region **304** respectively.

Barrier means **301** is configured to inhibit air which follows a vane **204, 205, 206, 207** rotating into a barrier sector from discharging outside of the vane free edge path **212** whilst that vane **204, 205, 206, 207** is rotating through the barrier sector. In this way, the barrier means **301** functions to enhance the rotative effect of air entering the barrier sector.

In the example shown in *Figure 3*, barrier means **301** is configured to provide two barrier sectors which each extend over the distance between the front edge of two vanes **204, 205, 206, 207** of rotary part **201**. Thus, barrier means **301** is configured to provide two barrier sectors each of approximately ninety degrees.

#### **Figure 4**

*Figure 4* shows a simplified section view, along the line I-I shown in *Figure 1*, through the first rotary section **105** of wind powered generator **101**. First rotary part **401**, which comprises a hub **402** and four arcuate vanes **403, 404, 405, 406** extending therefrom in a similar arrangement to that of rotary part **201**, is arranged to rotate about an axis of rotation through the centre of axial shaft **407**.

Arranged in stationary relation to rotary part **401**, is barrier means **408** providing first and second barrier sectors between an air inlet region **409** and an air outlet region **410**.

Inlet ducting **109** is arranged to direct inflowing air, flowing in the



direction generally indicated by arrow A, towards air inlet region 409. In the illustrated example, inlet air ducting 109 is arranged to direct a flow of air through the air inlet region 409 such that the air impinges on the underside of a vane 403, 404, 405, 406 to rotate the rotary part 401 in the direction indicated by arrows F (in *Figure 4*, this direction is clockwise from inlet air ducting 109 to outlet air ducting 110). Air flowing through the barrier means 408 from air inlet region 409 is discharged through air outlet region 410. Outlet air ducting 110 is arranged to direct outflowing air, flowing in the direction generally indicated by arrow B, away from air outlet region 410.

In this example, the area of air inlet region 409 is approximately half that of the area of air outlet region 410. This relationship provides for a partial vacuum to be created within the vane free edge path of rotary part 401 at the air outlet region 410, as rotary part 401 rotates in the direction indicated by arrows F; to enhance the rotative effects of air flowing from air inlet region 409.

In addition, barrier means 408 is configured to provide two barrier sectors between air inlet region 409 and air outlet region 410, in the direction indicated by arrows G, arranged to provide for a vortex to be created within the vane free edge path of rotary part 401 as rotary part 401 rotates; a vortex enhancing the rotative effects of air flowing in the vane free edge path of rotary part 401.

Rotary part 401 also comprises binding means, in the shown configuration, between the front edge of each vane 403, 404, 405, 406 and the bottom of the succeeding vane 403, 404, 405, 406, extending between the underside of the vane 403, 404, 405, 406 and the topside of the

succeeding vane 403, 404, 405, 406; for example cable 411 extending between the underside 412 of vane 404 and the topside 413 of vane 405. Rotary part binding means are configurable to stabilise the relative positions of the vanes 403, 404, 405, 406, as rotary part 401 rotates, to regulate the amount of deflection experienced by the vanes 403, 404, 405, 406 as rotary part 401 rotates and/or such that a vane 403, 404, 405, 406 being acted upon by rotative air flows a succeeding vane 403, 404, 405, 406.

10 **Figure 5**

*Figure 5* shows a simplified section view, along the line II-II shown in *Figure 1* (in the same direction as along parallel line I-I), through the second rotary section 106 of wind powered generator 101. Second rotary part 501, which comprises a hub 502, four arcuate vanes 503, 504, 505, 506 extending therefrom and binding means, in a similar arrangement to that of rotary part 401. Rotary part 501 is also arranged to rotate about the same axis of rotation along the centre of axial shaft 407 as rotary part 401.

Arranged in stationary relation to rotary part 501, is barrier means 507, providing first and second barrier sectors between an air inlet region 508 and an air outlet region 509. In this example, the area of air inlet region 508 is approximately half that of the area of air outlet region 509.

Inlet ducting 109 is arranged to direct inflowing air, flowing in the direction generally indicated by arrow A, towards air inlet region 508. In the illustrated example, inlet air ducting 109 is arranged to direct a flow of air through the air inlet region 508 such that the air impinges on the underside

of a vane 503, 504, 505, 506 to rotate rotary part 501 in the direction indicated by arrows H (in *Figure 5*, this direction is anti-clockwise from inlet air ducting 109 to outlet air ducting 110). Thus, rotary part 501 is arranged to rotate about axial shaft 407 in the opposite direction to rotary part 401 when  
5 exposed to the same air flow through the generator 101, indicated in *Figures 1, 4 and 5* generally by arrows A and B. Air flowing through the barrier means 507 from air inlet region 508 is discharged through air outlet region 509. Outlet air ducting 110 is arranged to direct outflowing air, flowing in the direction generally indicated by arrow B, away from air outlet region 509.

10. Third rotary section 107 of wind powered generator 101 is similar in arrangement to rotary section 105, with the third rotary part (shown in *Figure 9*) being similar to first rotary part 401 and arranged to rotate in the same direction about the axis of rotation along the centre of axial shaft 407.

#### 15 **Figure 6**

Wind powered generators installed in natural wind environments are subject to fluctuations in the inflowing air flow.

*Figure 6* shows the same arrangement as shown in *Figure 5*, with the addition of adjustable air flow control means 601, configured to provide  
20 a means of regulating the flow of air into air inlet region 602. In this example, air flow control means 601 is a screen configured to be moveable in the directions indicated by double-headed arrow J, between a fully open position, in which the air flow through air inlet region 602 is unrestricted by the air flow control means 601, and a fully closed position, in which the air  
25 flow control means 601 prevents the inflow of air from the inlet air ducting

603 through air inlet region 602. In the example shown in *Figure 6*, inlet air ducting 603 is configured to receive the air flow control means screen 601 in a channel 604 formed therein. Alternative embodiments of air flow control means include shutters and venetian blind style arrangements.

5

### ***Figure 7***

As shown in *Figure 7*, which shows an enlarged view of wind powered generator 101, inlet air ducting 109 is arranged to have an inlet 701, allowing air to flow into the inlet air ducting 109 from the natural wind environment, common to rotary sections 105, 106, 107, and an outlet 702, 703, 704 individual to each rotary section 105, 106, 107 respectively, allowing air to flow from the inlet air ducting 109 into the air inlet region of each rotary part in each rotary section 105, 106, 107. Thus, inlet air ducting 109 has a single inlet 701 common to rotary sections 105, 106, 107 and three outlets 702, 703, 704.

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Alternative inlet air ducting includes ducting having an inlet common to more than one rotary section, ducting having an outlet common to more than one rotary section, ducting having an inlet and an outlet individual to a rotary section and ducting having combinations thereof.

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Outlet air ducting 110 is arranged to have an inlet 705, 706, 707 allowing air to flow into the outlet air ducting 110 from the air outlet region of each rotary part in each rotary section 105, 106, 107, individual to each rotary section 105, 106, 107 respectively, and an outlet 708, 709, 710 individual to each rotary section 105, 106, 107 respectively, allowing air to flow from the outlet air ducting 110 into the natural wind environment. Thus,

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outlet air ducting 110 has three inlets 705, 706, 707 and three outlets 708, 709, 710.

Alternative outlet air ducting includes ducting having an inlet common to more than one rotary section, ducting having an outlet common to more than one rotary section, ducting having an inlet and an outlet individual to a rotary section and ducting having combinations thereof.

Air inlet ducting and air outlet ducting that is all or in part releasably attachable to a wind powered generator is utilisable. This feature allows for a number of wind powered generators of similar construction to be equipped with different ducting, for example according to the installation site of the wind powered generator or the wind environment, whether the wind environment is natural or not. Removable ducting provides for more convenient maintenance of, and transportation of, a wind powered generator embodying the present invention.

Air inlet ducting and outlet ducting that is configured to be adjustable is utilisable. For example, a configuration of air inlet ducting has an inlet section that is adjustable such that the inlet is directable into a flow of air.

Due to the potential variability of ducting between wind powered generators embodying the present invention, the position and construction of air flow control means is correspondingly variable. For example, alternative embodiments of air flow control means includes air flow control means individual to a rotary section, or air flow control means common to more than one rotary section. In addition, the position of air flow control means relative to a rotary section is also variable, for example, referring to inlet air ducting means 109 shown in *Figure 7*, air flow control means may

be positioned at each of the outlets 702, 703, 704 or may be positioned at the common inlet 701. Air flow control means may be operated manually, in response to data received from sensors, via a control program, with controls at or remote from the wind powered generator. Each air flow control means may be arranged to be adjusted independently of each other and/or in common with another.

**Figure 8**

In a wind powered generator embodying the present invention, at least one rotary part is operatively connected to current generating means comprising generator means and second generator means arranged to generate electric current in response to relative rotation between said first and second generator means.

Figure 8 shows a simplified schematic (with a cut-away section) of an example arrangement of current generating means utilisable in a wind generator embodying the present invention. Current generating means 801 comprises first generator means 802 and second generator means 803; in this example, first generator means 802 is fixedly mounted about an axial shaft 804 and second generator means 803 is arranged about first generator means 802, such that the first and second generator means 802, 803 are concentric about an axis of rotation along the centre of axial shaft 804.

According to the shown arrangement, first generator means 802 comprises an electrical armature comprising a soft iron core 805 about which electrical windings 806 configured to carry electric current are wound,

and second generator means **803** comprises a plurality of permanent magnets **807** secured in a sleeve **808**. This arrangement is a sleeve arrangement, in which the permanent magnets **807** are portably held in position relative to each other.

5           With the arrangement shown in *Figure 8*, electric current is generated in response to relative rotation between the first and second generator means **802**, **803**, for example in response to the rotation of one of the first and second generator means **802**, **803** relative to the other of the first and second generator means **802**, **803** with only one, or both, being  
10           rotatable about the axis of rotation through axial shaft **804** relative to the other.

### **Figure 9**

*Figure 9* shows a simplified schematic (with a cut-away sections) of  
15           the arrangement of the current generating means and the first, second and third rotary parts **401**, **501**, **901** respectively of wind powered generator **101**.

As described previously, the first, second and third parts **401**, **501**, **901** are arranged to rotate about an axis of rotation along the centre of axial  
20           shaft **407**. First and third rotary parts **401**, **901** are arranged to rotate in a first direction about the axis of rotation, indicated by arrows K, and second rotary part **501**, which is interposed between the first and third rotary parts **401**, **901**, is arranged to rotate in the opposite second direction about the  
axis of rotation, indicated by arrow L, when the air inlet region associated with  
25           each rotary part **401**, **501**, **901** is exposed to a flow of air perpendicular to the

axis of rotation, indicated generally by arrow M.

As shown in *Figure 9*, the hub **502** of rotary part **501** is substantially hollow. Similarly, the hub **402**, **902** of first and third rotary parts **401**, **901** are substantially hollow. The hub of a rotary part utilised by a wind powered generator embodying the present invention may or may not be substantially hollow, for example, according to the arrangement of the rotary part relative to the generator means of the wind powered generator and/or to reduce the weight of a rotary part.

The current generating means **903** utilised in wind powered generator **101** comprises first generator means **904** and second generator means **905**. First generator means **904** is mounted about axial shaft **407**, within the hub **502** of second rotary part **501**. Second generator means **905** is arranged within the hub of second rotary part **501**, about first generator means **904**, such that the first and second generator means **904**, **905** are concentric about the axis of rotation through axial shaft **407**.

First and third rotary parts **401**, **901** are operatively connected to first generator means **904**. First and third rotary parts **401**, **901** are operatively connected to first generator means **904** such that as the first and third rotary parts **401**, **901** rotate in a first direction about the axis of rotation, for example in the direction indicated by arrow K, first generator means **904** is rotated in the same direction. First and third rotary parts **401**, **901**, and first generator means **904** are fixedly mounted about axial shaft **407**, such that axial shaft **407** is rotated in the same direction. According to this arrangement, axial shaft **407** is journalled on bearings provided by a support structure (not shown).



Second rotary part is operatively connected to second generator means **905**. Second rotary part is operatively connected to second generator means **905** such that as the second rotary part **501** rotates in a first direction about the axis of rotation, for example in the direction indicated by arrow L, second generator means **904** is rotated in the same direction. Second rotary part **502** is mounted about axial shaft **407** such that second rotary part **502** rotates around axial shaft **407**.

Thus, wind powered generator **101** is configured to provide for contra-rotation of the first and second generator means **904**, **905**.

In this example, first generator means **904** comprises an electrical armature comprising a soft iron core **906** about which electric windings **907** configured to carry electrical current are wound, and second generator means **905** comprises a plurality of permanent magnets **908** secured in a sleeve **909**. A sleeve arrangement facilitates construction of a wind generator embodying the present invention, provides for generator means to be secured in a sleeve arrangement utilising a different material to that utilised in a rotary part, allows generator means to be secured to a rotary part indirectly, and facilitates the arrangement of a uniform air gap between first and second generator means. In this example, sleeve **909** is configured to be removably secured to second rotary part **501**. Alternatively, the permanent magnets **908** may be directly secured within hub **502**.

As shown in *Figure 9*, the first and third rotary parts **401**, **901** are mounted about axial shaft **407** such that the vanes of each rotary part **401**, **901** are out of phase with each other. Associated with each of the first and third rotary sections **105**, **107** is an air inlet region for each of the first and

third rotary parts **401**, **901**, and this feature provides for a vane of either the first and third rotary parts **401**, **901**, to be exposed in one of these two air inlet regions at any moment in time.

Alternatively, as shown in *Figure 10*, the first and third rotary parts **401**, **901** are mounted about axial shaft **407** such that the vanes of each rotary part **401**, **901** are in phase with each other.

### **Figure 10**

*Figure 10* is a diagrammatic longitudinal section view, along the line III-III shown in *Figure 1*, through the first, second and third rotary section **105**, **106**, **107** and the generator electrical means section **108**. As shown in *Figure 10*, axial shaft **407** is configured to receive electrical connection means **1001** therethrough. Electrical connection means **1001** is configured to provide an electrical connection between the current generating means **903** and generator electrical means **1002**. Generator electrical means **1002** is positioned inside generator electrical means section **108**, which is positioned outside of the rotary sections **105**, **106**, **107** of the wind powered generator **101**. This feature facilitates the construction, transport and maintenance of wind powered generator **101**.

In this example, the electrical connection means **1001** electrically connects the current carrying windings **907** of first generator means **904** with slip rings and brushes contained in the generator electrical means section **108**. According to the shown arrangement, the electrical connection means **1001** comprises extension lengths of the windings **907** extending from the armature core **906** to the generator electrical means **1002**.

Alternatively, electrical connection means connected to the windings is utilisable.

As shown, electrical connection means **1001** does not extend all the way through axial shaft **407**. Thus, an alternative configuration of shaft  
5 configured to receive electrical connection means therethrough is configured to receive electrical connection means through a part of the full length of the shaft.

The shown electrical arrangement utilised by wind powered generator **101** is such that alternating electric current (a.c.) is generated.  
10 Alternatively, an electrical arrangement of current generating means configured to generate direct current (d.c.) is utilisable. The components of the generator electrical means are thus variable depending on the current generating means utilised. For example, externally or self excited electromagnets may be utilised in place of permanent magnets. Shafts  
15 utilisable in a wind powered generator embodying the present invention include shafts configured to receive therethrough a single, or multiple pairs of electric current carrying connections, for example electric cables. A utilisable shaft is provided with packing material, for example electrically  
20 insulating material, to surround, cushion and/or position electrical connection means within the shaft.

### **Figure 11**

*Figure 11* is a diagrammatic longitudinal section view through a wind powered generator **1101** embodying the present invention. Wind powered  
25 generator **1101** is similar in construction to wind powered generator **101**,

configured as a modular assembly. The axial shaft 1102 is configured in first, second, third and fourth sections 1103, 1104, 1105, 1106 corresponding to first, second and third rotary sections 1107, 1108, 1109 and generator electrical means section 1110 respectively. Each section 1103, 1104, 1105, 1106 is configured to be releasably engageable with at least one other section. In the illustrated example, at least one end of each section 1103, 1104, 1105, 1106 is castellated.

Electrical connection means 1111 is also configured to be separable into sections 1112, 1113, 1114. At least one end of each section is provided with an electrical connection junction section, configured to be releasably engageable with at least one other junction section. For example, junction section 1115 of electrical connection means section 1112 is configured to be releasably engaged with junction section 1116 of electrical connection means section 1113.

This feature facilitates the transport, construction, and maintenance of wind powered generator 101, and facilitates the replacement of a section or component thereof.

### **Figure 12**

Figure 12 shows a rotary part 1201 utilisable in a wind powered generator embodying the present invention, having a hub 1202 configured to allow air to flow through the rotary part 1201, in particular as the rotary part 1201 rotates. For example, rotary part 1201 is configured such that as rotary part 1201 rotates in the direction indicated by arrow N, air flows into the hub 1202, in the direction indicated by arrow P, through the hub 1202

and flows out of the hub **1202**, in the direction indicated by arrow Q. Rotary part **1201** is configured such that as rotary part **1201** rotates in a first direction about an axis of rotation, air flows through the hub **1202** in a direction along the axis of rotation. This feature provides for air flow through  
5 the rotary part **1201**, to cool any generator means or electrical connection means inside the rotary part **1201**.

## Claims

1. A generator for generating an electric current comprising  
current generating means comprising first generator means and  
5 second generator means arranged to generate electric current in response  
to relative rotation between said first and second generator means;  
a first rotary part having vanes, said first rotary part arranged to  
rotate in a first direction around an axis when exposed to a flow of air  
perpendicular to said axis; said first rotary part operatively connected to a  
10 first of said first and second generator means; and  
said axis is through an axial shaft about which said rotary part is  
arranged to rotate, wherein  
said axial shaft is configured to receive electrical connection means  
therethrough, said electrical connection means configured to provide an  
15 electrical connection between said current generating means and generator  
electrical means.
2. A generator according to claim 1, further comprising a second  
rotary part having vanes, said second rotary part arranged to rotate in a  
20 second opposite direction around said axis when exposed to a flow of air  
perpendicular to said axis; said second rotary part operatively connected to  
a second of said first and second generator means.
3. A generator according to claim 1 or claim 2, further comprising  
25 a third rotary part arranged to rotate in the same direction as, and

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operatively connected to the same generator means as, said first rotary part.

5           5.     A generator according to any preceding claim, wherein said axial shaft comprises sections each releasably engageable with at least one other section.

10           6.     A generator according to preceding claim, wherein said electrical connection means comprises sections each releasably engageable with at least one other section.

15           7.     A generator according to any preceding claim comprising a rotary part configured to allow air to flow through said rotary part in a direction along said axis during rotation.

            8.     A generator according to claim 3, configured such that the vanes of said first rotary part and said third rotary part are out of phase with each other.

20           9.     A generator according to any preceding claim comprising a rotary part having a hub from which a plurality of arcuate vanes extend.

25           10.    A generator according to any preceding claim comprising a rotary part having rotary part binding means extending between two adjacent vanes.

11. A generator according to any preceding claim, wherein said current generating means comprises generator means secured in a sleeve arrangement, said sleeve arrangement configured to be positioned inside a rotary part such that said generator means is arranged about said axis.

12. A generator according to claim 11, wherein said sleeve arrangement comprises permanent magnets.

13. A generator according to claim 3, wherein said first and third rotary parts are arranged to rotate in said first direction and are operatively connected to said first generator means, said first generator means comprising an armature, and said second rotary part is operatively connected to said second generator means, said second generator means comprising permanent magnets.

14. A generator according to claim 13, in which said first and second generator means are arranged within said second rotary part.

15. A generator according to any preceding claim comprising generator electrical means positioned outside of the rotary section or sections of said generator.



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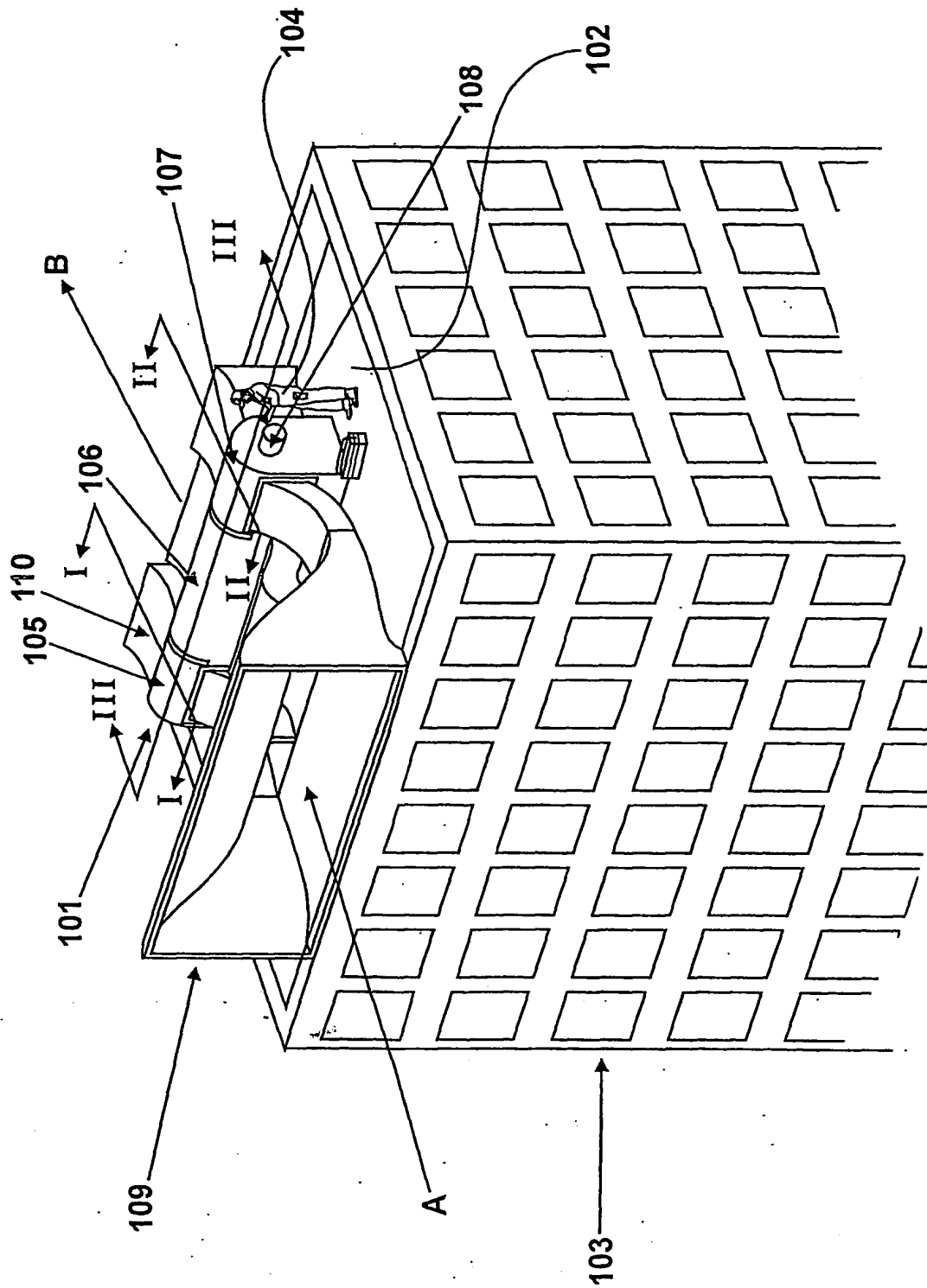
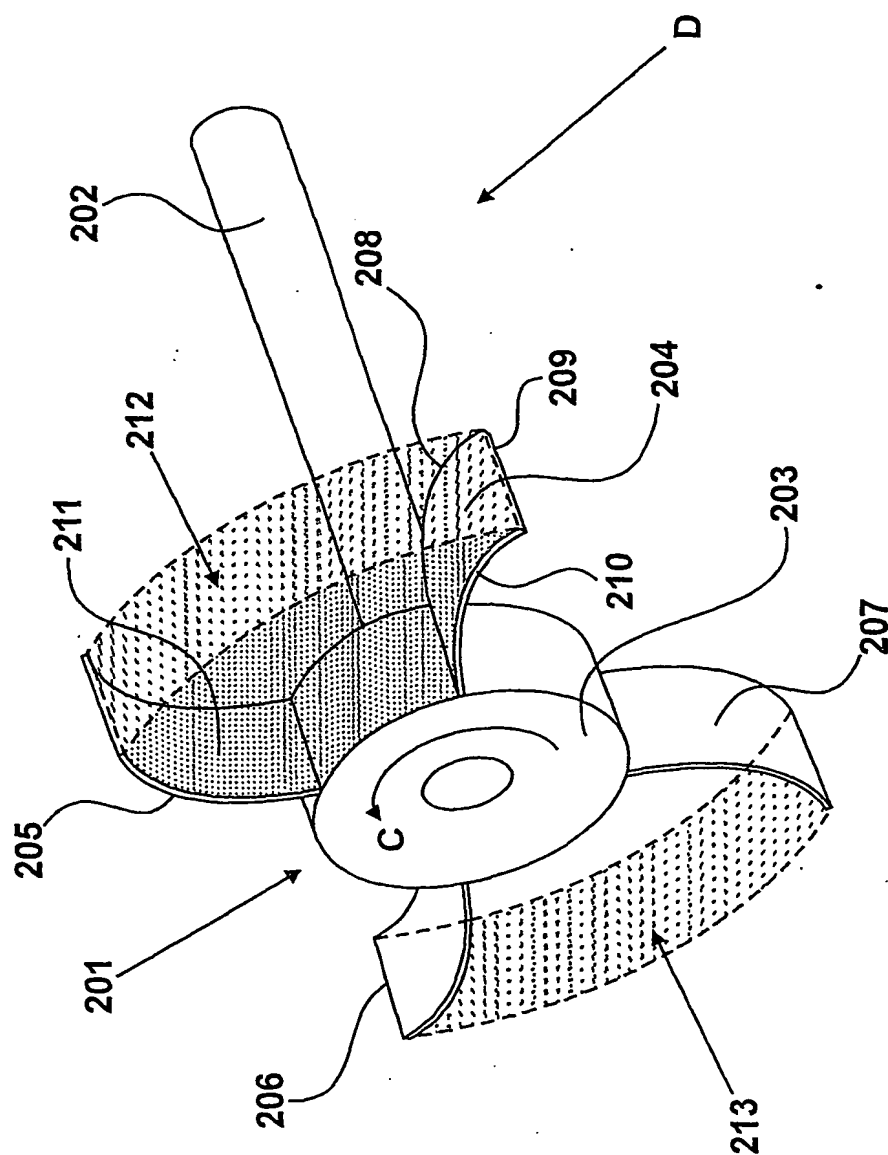


Figure 1



**Figure 2**

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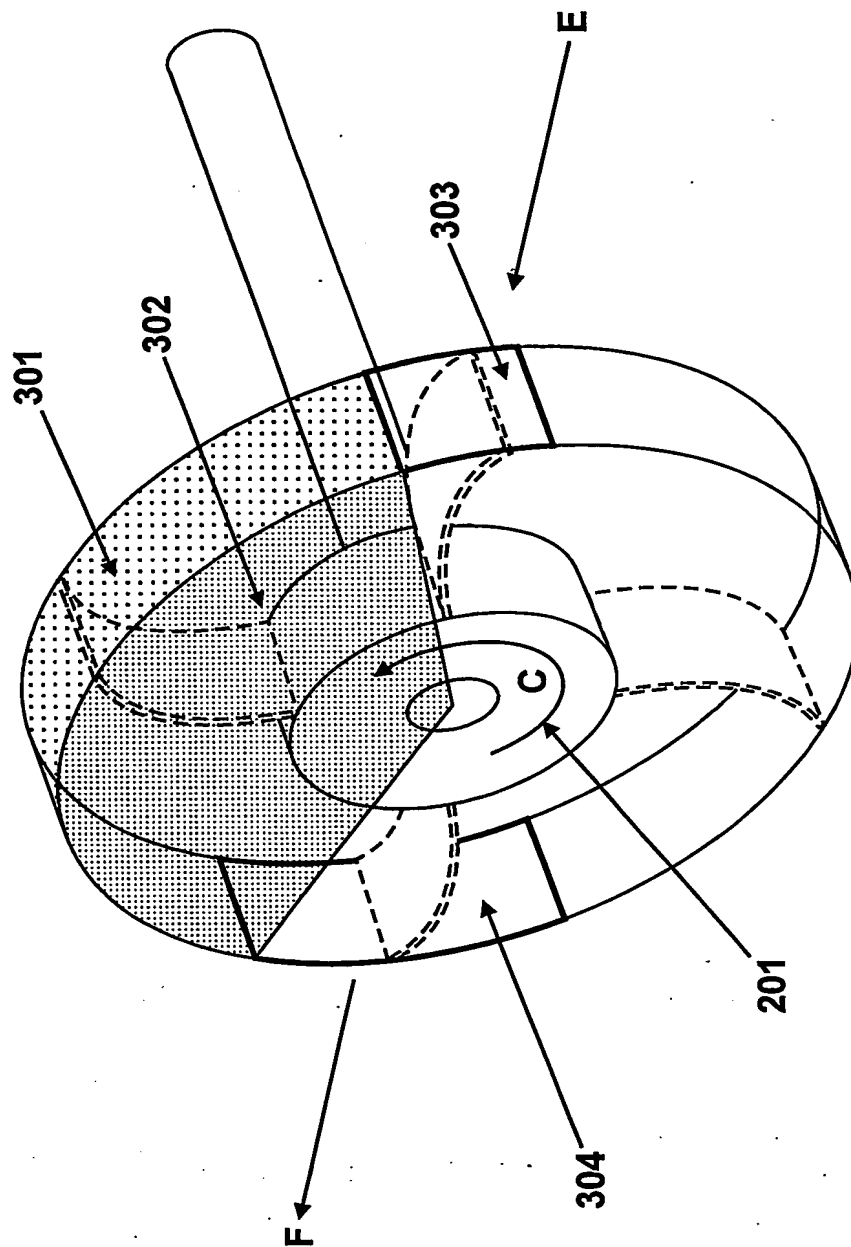


Figure 3

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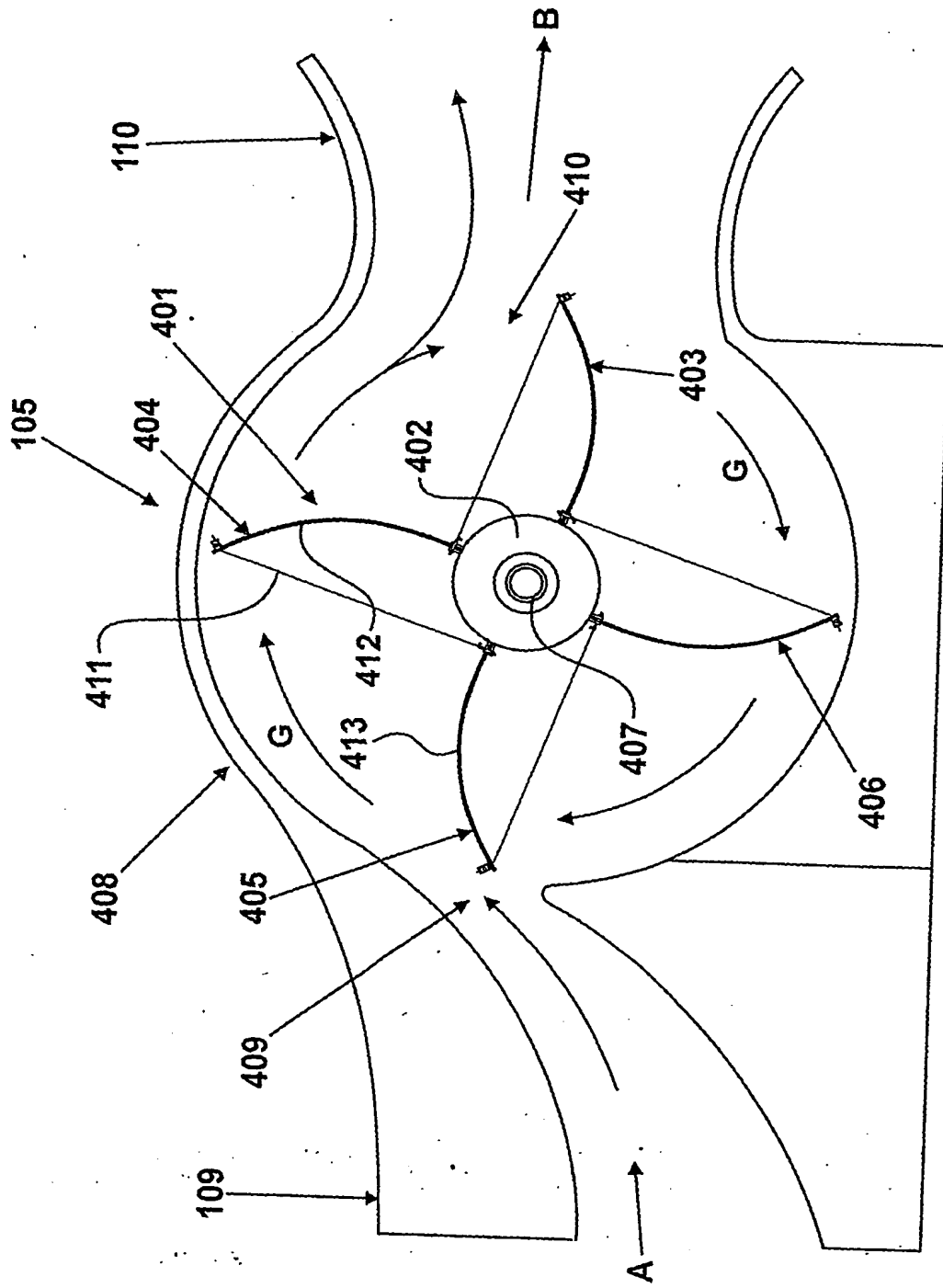
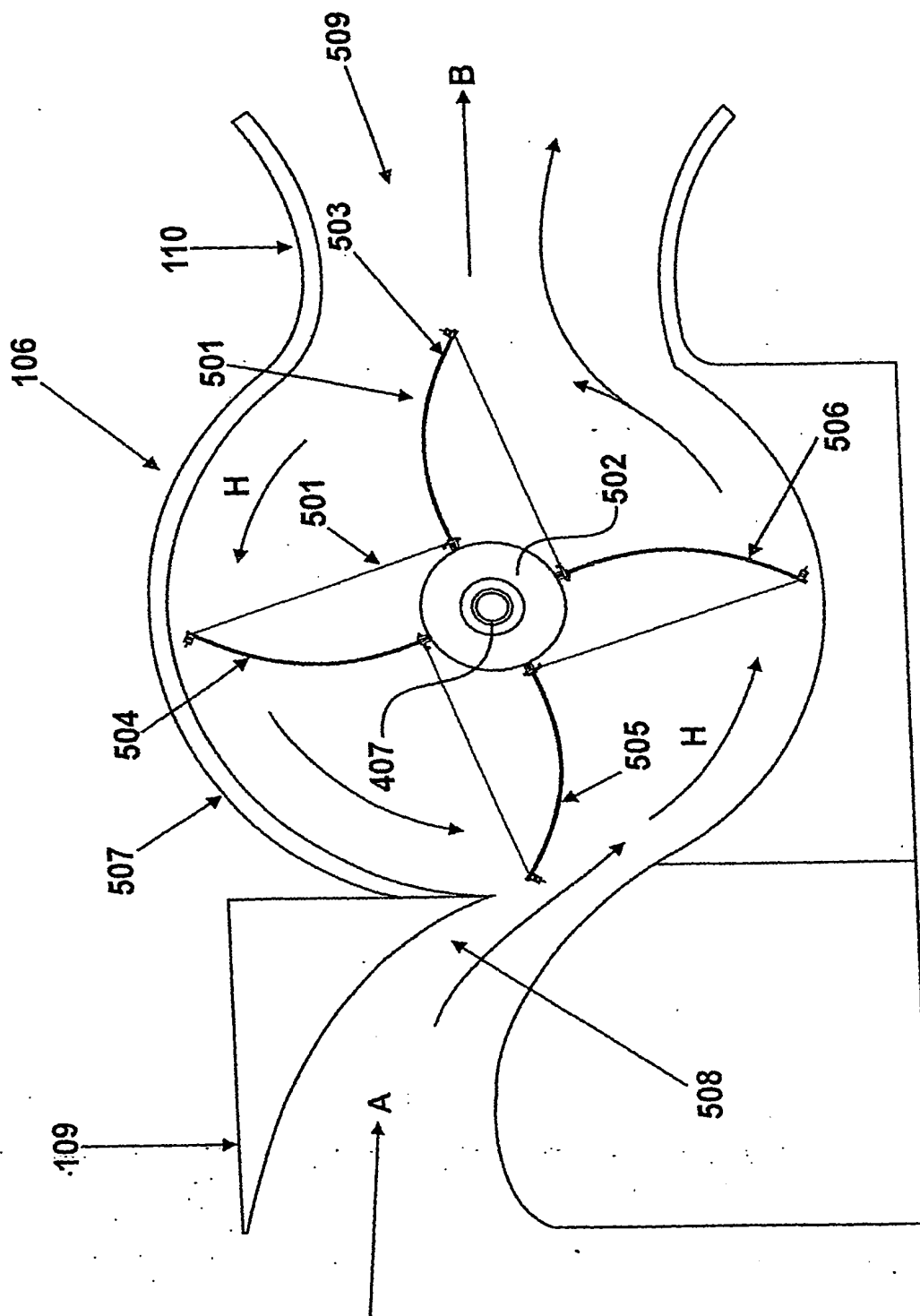


Figure 4

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## Figure 5

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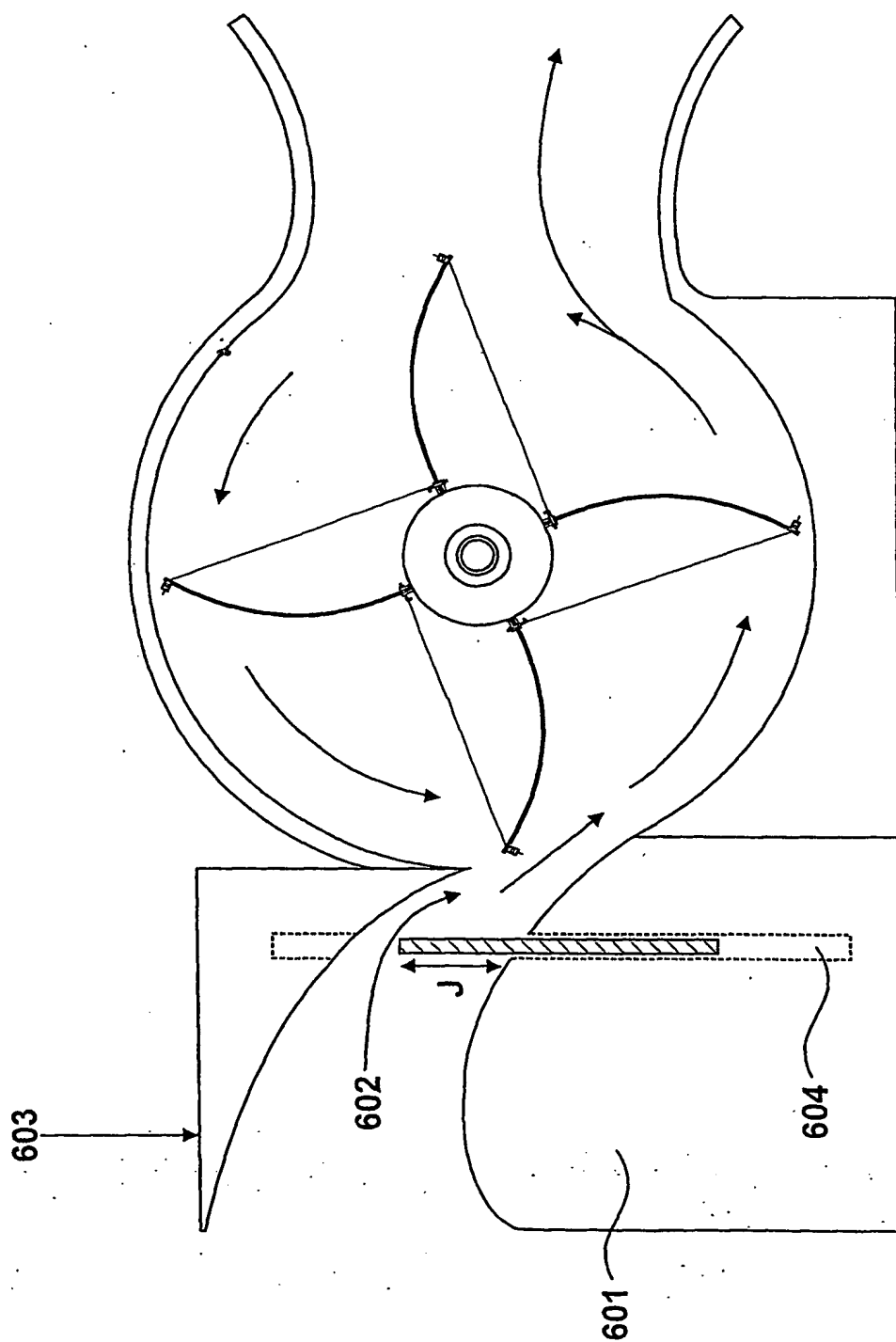
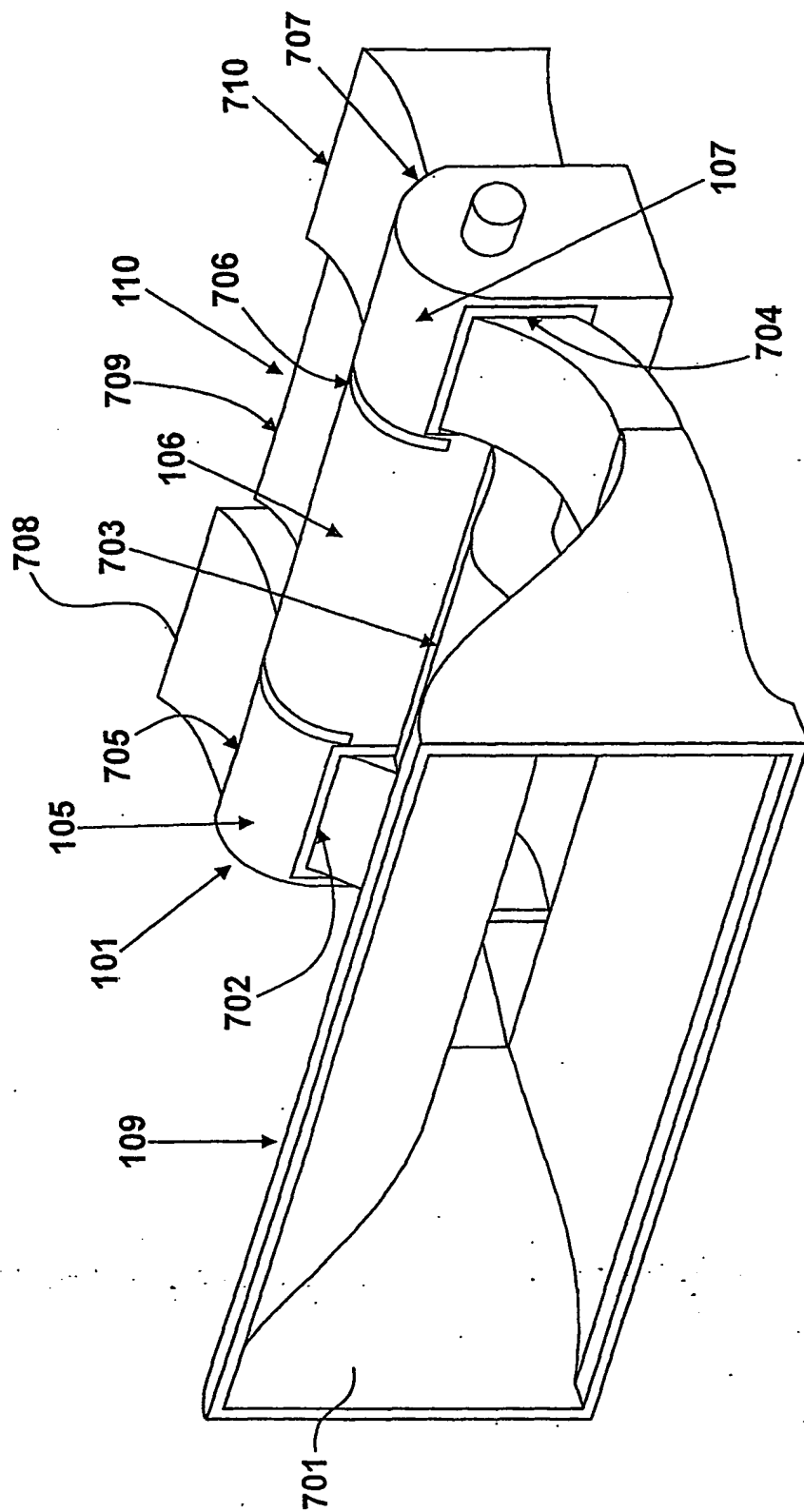


Figure 6

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## Figure 7

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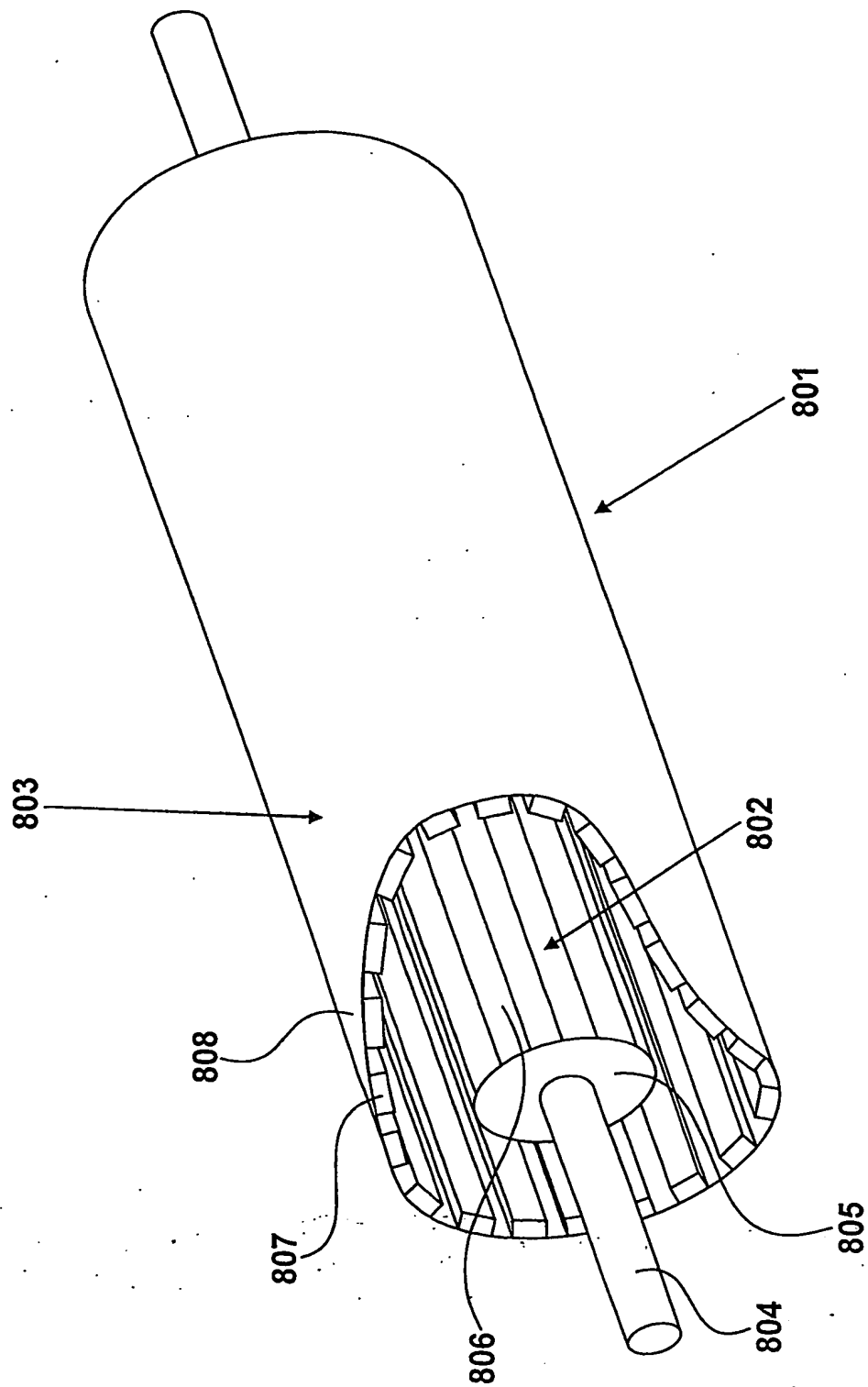
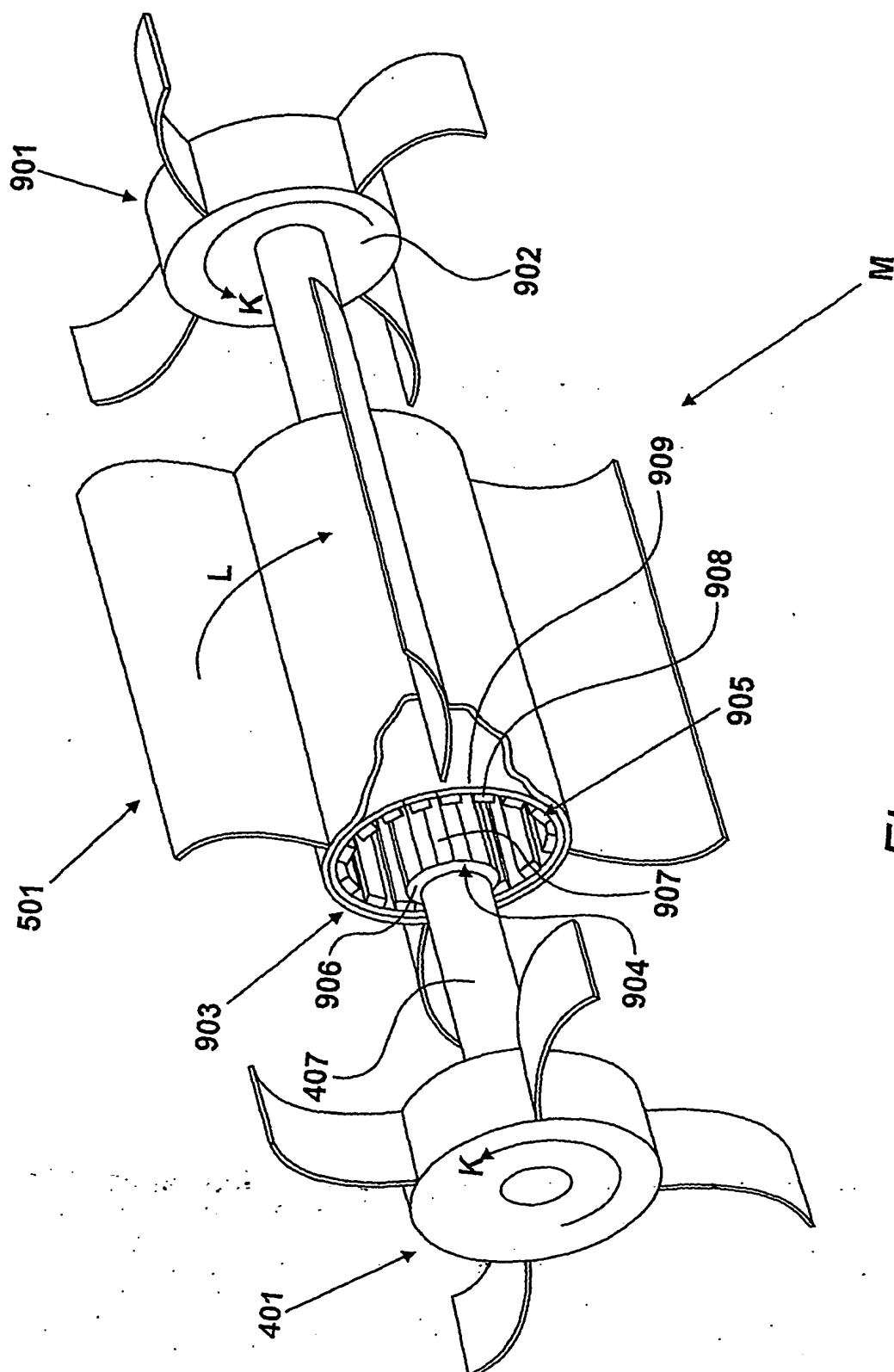


Figure 8



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**Figure 9**

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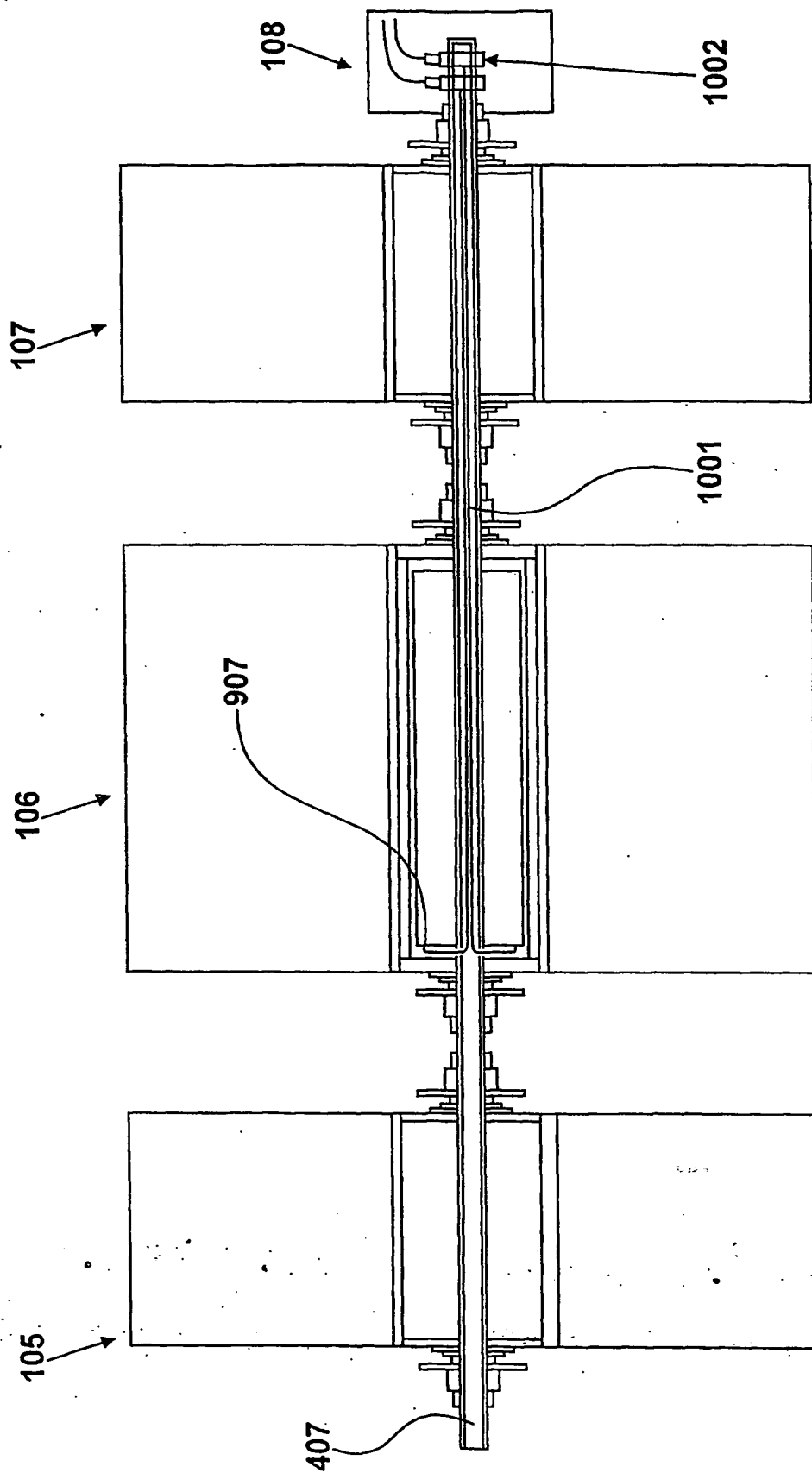


Figure 10

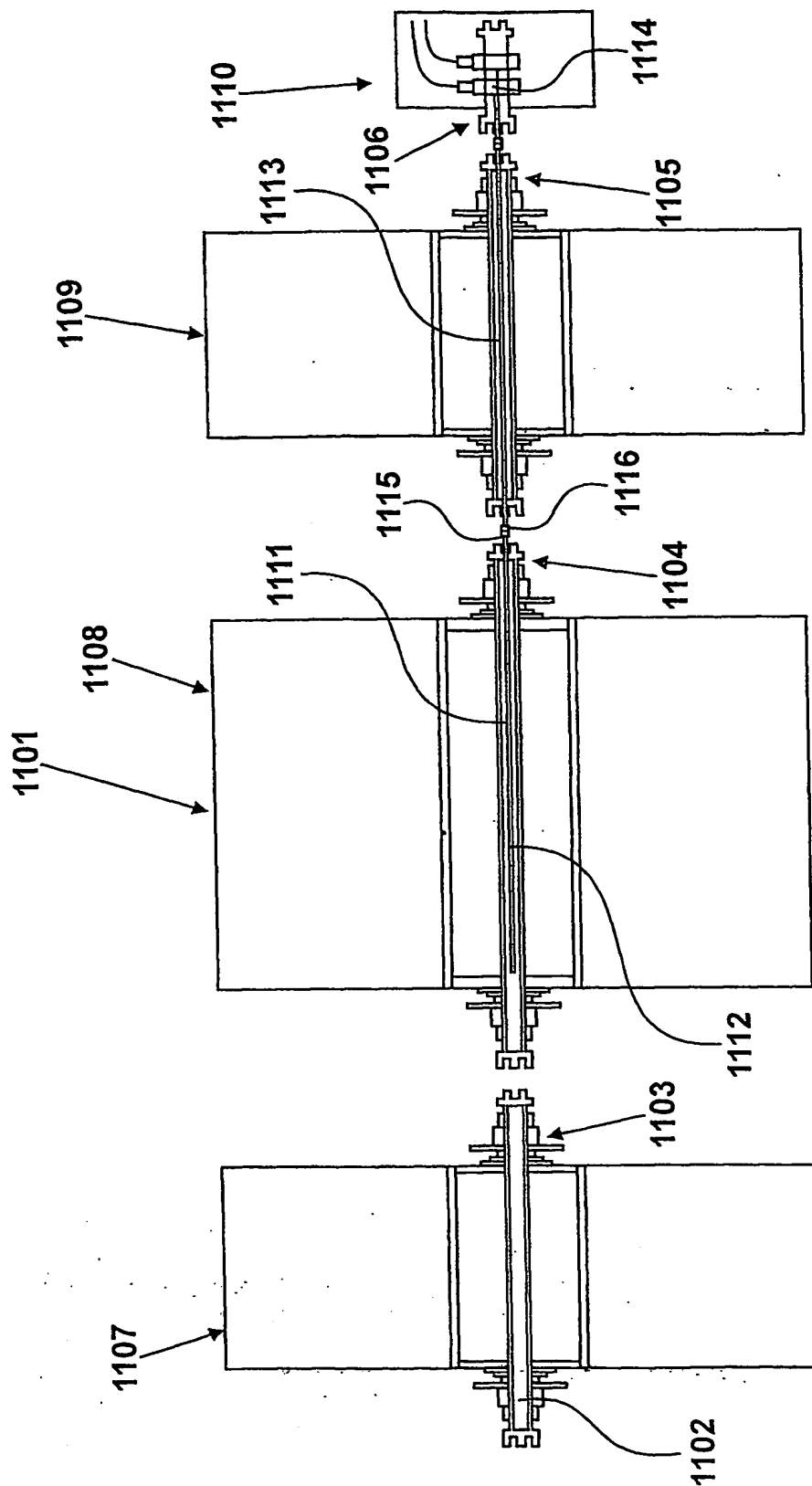


Figure 11

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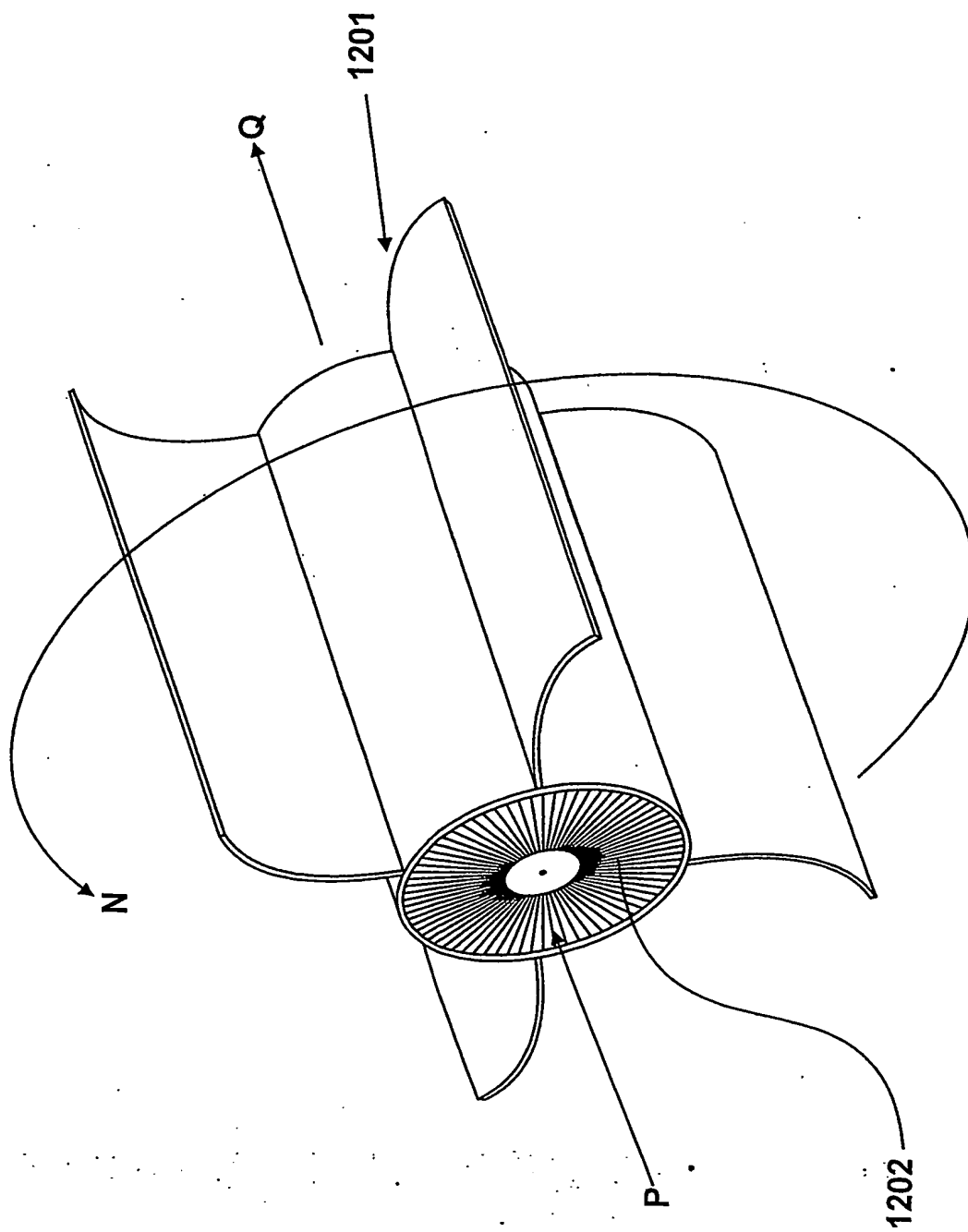


Figure 12

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/GB2004/002353

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F03D9/00 F03D3/00 F03D3/02 F03D3/04 F03D3/06  
H02K16/00 H02K7/18

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F03D H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 341 646 A (SHERIDAN BERNARD JOHN) 22 March 2000 (2000-03-22) cited in the application page 3, line 23 - line 27 figures	1-3, 9, 11-15
X	US 3 697 765 A (CARINI EUGENE P.) 10 October 1972 (1972-10-10) column 2, line 63 - line 65 column 2, line 66 - column 3, line 2 column 4, line 5 - line 7 figures	1, 2, 9, 11, 12, 15
X	US 4 061 926 A (PEED PAUL V) 6 December 1977 (1977-12-06) figures 1-3	1, 2, 10, 11, 15
	-/--	

☒ Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search

10 September 2004

Date of mailing of the international search report

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X	US 6 172 429 B1 (RUSSELL THOMAS H) 9 January 2001 (2001-01-09) figures 2,3,8 -----	1,2,11, 13,15

**INTERNATIONAL SEARCH REPORT**

on on patent family members

International Application No

PCT/GB2004/002353

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2341646	A	22-03-2000	NONE
US 3697765	A	10-10-1972	NONE
US 4061926	A	06-12-1977	NONE
US 6172429	B1	09-01-2001	US 6097104 A 01-08-2000